



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

of the five eggs and perhaps the easiest to rear. The eggs may be arranged according to size, depth of color and ease with which they may be reared as follows:

Size	Depth of Color	Ease of Rearing
<i>Diopatra</i>	<i>Diopatra</i>	<i>Diopatra</i>
<i>Platynereis</i>	<i>Chaetopterus</i>	<i>Platynereis</i>
<i>Nereis</i>	<i>Nereis</i>	<i>Chaetopterus</i>
<i>Chaetopterus</i>	<i>Platynereis</i>	<i>Pectinaria</i>
<i>Pectinaria</i>	<i>Pectinaria</i>	<i>Nereis</i>

As in the case of *Platynereis* the essential point in rearing these annelids is to give them food at just the right time in the larval stage. This time varies somewhat with each form. Briefly, food must not be given before the yolk and oil are wholly used up. One needs but to watch the larvæ, note the disappearance of the oil from the gut, and then add diatoms.

E. E. JUST

HOWARD UNIVERSITY

REFERENCES

Hempelmann, F.

- '11. Zur Naturgeschichte von *Nereis dumerilii* Aud. et Edw. Zoologica, Bd. 25, Lief 1 (Heft 62).

Just, E. E.

- '14. Breeding Habits of *Platynereis megalops* at Woods Hole, Mass. Biol. Bull., 27.

Lillie, F. R. and Just, E. E.

- '13. Breeding Habits of the *Heteronereis* Form of *Nereis limbata* at Woods Hole, Mass. Biol. Bull., 24.

AN OBSERVATION ON THE "CLUSTER-FORMATION" OF THE SPERMS OF CHITON¹

WHILE engaged with an inquiry into the natural history of the chitons, in 1918,² I several times made an observation which may have a bearing on the significance of sperm-clusters, and on the mechanism of their formation. The matter could not at the time be adequately investigated, but since I shall not soon be in a position to examine it further my observations are here related for what they may be worth. The species concerned is *Chiton tuberculatus* Linn., an intertidal form quite abundant at Bermuda. It is necessary to note, first, certain features of the breeding process, which seems to me to have heretofore been

¹ Contributions from the Bermuda Biological Station for Research. No. 119.

² The corrected proof and manuscript of this article were returned to the publisher Aug. 18, 1920; but the corrected article was accidentally taken out of type in the office of the printers. The author has now rewritten the paper. E. L. M.

somewhat misunderstood. In another connection I shall describe several aspects of the reproductive activities of these animals, the present remarks having to do merely with the act of fecundation.

Although it has commonly been held that the liberation of eggs by a female chiton is due to the reception of spermatie fluid diffusing into her respiratory water-currents from a nearby male, the process of fertilization would appear in fact to be initiated in a quite different manner. Stated briefly, the presence of one or more neighboring females serves in some way to activate the discharge of sperm by the males, the spermatie substances secondarily inducing the liberation of eggs. Normally this occurs only at those periods when the flow of the tide begins just before sunrise, the shedding of the genital products commencing as the chitons become covered by the sea. The discharge of sperm can, however, be induced artificially at certain times, in the laboratory, even a month or more before the eggs are matured.³ A method which several times yielded this result consisted in keeping some male chitons in a damp, darkened vessel for about 14 hours, then covering them with sea water and admitting light. It should be noted here that *C. tuberculatus* is an animal nicely fitted for observations of this kind, because the differential pinkish tint of the soft tissues of the females permits the quick and accurate identification of sex.⁴

In May, a month before ripe eggs are seen, it was noticed that when sperm diffusing from a male, in a glass dish, was taken up between the ctenidia of a female, it issued from the posterior ends of the ctenidial channels in an altered state, for the sperm-stream was then seen to contain numerous agglutinated masses of active sperms, which persisted in sea water for at least half an hour.

During natural fecundation, however, no sperm-balls are formed. The thick glutinous stream of spermatozoa passes under the girdle of a female, is somewhat diluted with sea water

³ That the discharge of sperm is under nervous control is indicated by the behavior of male *Chatopleura* following strychninization (cf. Crozier, 1920, *Jour. Gen. Physiol.*, Vol. 2, pp. 627-634).

⁴ See Crozier, W. J., 1920, "Sex-correlated Coloration in Chiton," *AMER. NAT.*, Vol. 54, pp. 84-88. Tidal, or rather lunar, periodicity in the liberation of gametes has been observed also in *Chatopleura*; I was able to note a probable lunar periodicity in this genus, in 1919, at Woods Hole, and the point is dealt with at length in a recent paper by Grave, B. H., 1922. *Biol. Bull.*, Vol. 42, pp. 234-256.

by the tractive current, and emerges posteriorly in company with numerous large greenish eggs, about which, under the microscope, it can be seen that many sperms are gathered. But no real "cluster-formation" takes place.

The body juices of the ripe female, whether or not diluted with sea water, do not cause agglutination of sperm suspensions. But ovarian extracts from (*mature*) eggs in sea water do induce decided and apparently typical agglutination. So far as I know, sperm-agglutination by ovarian extracts has not previously been seen in molluscs.⁵ Sea water into which ripe eggs have been shaken from an ovary and the whole allowed to stand for half an hour has a similar agglutinative effect.

Concerning the significance of the cluster formation, then, these two points seem significant: (1) the absence of such a process in normal fecundation, and (2) its conspicuous occurrence when sperm, before the real onset of the breeding season, has passed through the ctenidial channels of males or immature females. It could not be discovered whether or not the *mature* female in a non-spawning interval would cause this cluster production, because at such times the consistent response of a female to an impinging current of sperms was to depress the girdle to the substratum, thus cutting off the water current carrying sperms, and, by reducing the volume of the ctenidial channel, violently to expel from below the sperms already admitted.

These observations do not, of course, permit analysis of the rôle of egg-substances in fertilization of chiton, but do serve to point the contention that mere evidence of sperm agglutination (cluster formation) may well have no bearing on such analysis. It is possible that the sperms set free at a period before the natural ripening of eggs are in some degree immature, their surface perhaps more sticky, or liable to be made so by slight external changes experienced in passing between the gill filaments of another individual.

W. J. CROZIER

ZOOLOGICAL LABORATORY,
RUTGERS COLLEGE

⁵ Loeb, J., 1916, "The Organism as a Whole," x + 379 pp., New York.

Woodward, A. E., 1918, "Studies on the Physiological Significance of Certain Precipitates from the Egg Secretions of *Arbacia* and *Asterias*," *Jour. Exper. Zool.*, Vol. 26, pp. 459-501.

Just, E. E., 1919, "The Fertilization Reaction in *Echinarachnius parma*," II, *Biol. Bull.*, Vol. 36, pp. 11-38.